

Index

- A
- AAP (Apollo Applications Program)
See Skylab
- Aaron, John, 566
- Aberdeen Proving Ground, 12
- Ablation, 21–22
- ABMA
See Army Ballistic Missile Agency
- Abrahamson, James, 313, 356, 402, 549
- Acheson, David C., 375
- Adams, Leslie F. “Frank,” 366, 376
- Advanced Research Projects Agency (ARPA), 24–25
- Advanced X-ray Astrophysics Facility (AXAF), 249, 513, 598–99, 603
- Aero-Astroynamics Laboratory, 40, 93, 227
- Aeroballistics Laboratory, 40, 47, 94
- Aerojet, 280, 288, 291, 320
- Aeronautics Laboratory, 212
- Aeronomy, 600
- Aerospace Daily, 285–86
- African Americans
 and civil rights at MSFC, 116–25
 in Huntsville, 3, 126
 in MSFC workforce, 167
- Agnew, Spiro T., 150, 275
- AHAC. *See* Association of Huntsville Area Contractors
- Air Bearing Mobility Unit, 602
- Air Force
 early Shuttle studies, 273
 requirements for Shuttle, 280
- Air Force Rocket Propulsion Lab, 413
- Air Force system, 19, 42–45, 64
See also Army Arsenal system
- Aircraft Industries Association, 26
- Akridge, Max, 274, 276
- Alabama A&M University, 119–120, 153
- Albert, Frank R., 119
- Aldrich, Arnold, 377–78, 400–01
- All-up concept, 94
- Allen, Lew, 511–12
- American Federation of Government Employees (AFGE), 142
 and MSFC reductions-in-force (RIFs), 158
- American Science and Engineering Corporation, 241, 245
- Ames Research Center, 166, 430, 443, 555
- Anderson, Jack, 106
- Angele, Wilhelm, 194
- Antarctica, 179, 202

POWER TO EXPLORE: HISTORY OF MSFC

- Apocalypse, 402
- Apollo 11, 98–99
- Apollo 14, 250
- Apollo 15, 107
- Apollo 16, 107, 250
- Apollo 17, 107
- Apollo 4, 135
- Apollo 8, 98
- Apollo Applications Program (AAP), 137, 139, 533
 - See also Skylab*
- Apollo Command Module, 90, 196, 208
- Apollo fire, 179, 390
- Apollo Logistics Support System, 100
- Apollo Program, 115–16, 144
 - impact on MSFC, 596
 - See also* Lunar landing, Saturn, and Lunar Roving Vehicle
- Apollo Telescope Mount (ATM), 137, 139, 157, 184–86, 193–96, 199–200, 207, 214, 234–36, 599
- Apollo-Soyuz Test Project, 213, 251
- Armstrong, Neil, 99
- Army
 - and Arsenal system, 19–20
- Army Ballistic Missile Agency (ABMA), 21–22, 24–25, 40, 52, 80, 83–84, 117, 226–227, 595
 - and early Space Station concepts, 529–30
 - and launch of Sputnik I, 22–23
 - and space policy, 2
 - restrictions vs. competition with Project Vanguard, 21
 - transfer to NASA, 1
- Army Chemical Corps, 14
- Army Missile Command, 413
- Army Ordnance Missile Command, 30
- ARPA. *See* Advanced Research Projects Agency
- Arsenal system, 39–45, 64–65, 136, 193, 237–38
 - at Peenemünde, 5–6
 - attempts to retain at MSFC, 148
 - background of, 19
 - demise of at MSFC, 165, 168
- Association of Huntsville Area Contractors (AHAC), 119, 122, 124
- Astrionics Laboratory, 41, 47, 96, 104, 194, 197, 206, 603
- Astronaut training, 443
- Astronautics Laboratory, 104, 206
- Astronauts, 82, 201, 210
 - See also Skylab*
- Astronomy, 599
- Astrophysics, 599

- Atlantic Missile Range, 23
 ATM (Apollo Telescope Mount). *See* Apollo Telescope Mount and *Skylab*
 Automatic responsibility, 47, 96, 197, 261, 490
 B
 Balloon flights, 246
 Beggs, James, 313, 390, 400, 402, 498–99, 500–02, 504, 509, 556, 566
 and Space Station development plans, 551–53
 support for Space Station as NASA administrator, 547–48
 Belew, Leland, 48, 182–83, 188, 199, 202, 204, 206, 212
 Bell Labs, 398
 BellComm, 69, 150, 275
 Bendix Corporation, 194, 238
 Benisimon, Marc, 567
 Berglund, Rene, 536–37
 Bermuda, 214
 Berry, Charles A., 202, 204
 Bignier, Michel, 447
 Birmingham, Alabama
 and civil rights, 118
 Black Brant VC rockets, 252
 Bledsoe, Ron, 300
 Bless, Robert, 501
 Boeing, 66, 86–87, 96, 102–03, 105–06, 127, 192, 272, 484, 492, 563, 578
 as MSFC contractor on *International Space Station*, 582
 proposal (successful) for MSFC Space Station Work Package 1, 574
 Boggs, Hale, 121
 Boisjoly, Roger, 358, 364–65, 372–73, 375
 Borman, Frank, 536
 Bovee and Crail, 297
 Boykin, Frank, 122
 Bridwell, Porter, 303, 305, 321–22
 Brooksbank, William, 534, 537, 541
 named to head MSFC Space Station task team, 536
 Broussard, Peter, 42, 105, 256
 Brown Engineering. *See* Teledyne-Brown Engineering
 Brown, Bill, 284–85
 Brucker, Wilbur M., 23, 27
 Buchanan, Jack, 375
 Budget, federal
 Fiscal Year 1971, 157
 Fiscal Year 1972, 159
 Fiscal Year 1974, 163
 Fiscal Year 1981, 454
 Fiscal Year 1982, 454
 Fiscal Year 1984, 551
 Fiscal Year 1988, 579

POWER TO EXPLORE: HISTORY OF MSFC

- Building block concept, 93
- Bunn, Wiley, 397–98, 403
- Bureau of the Budget
 - and funding for Space Station, 533
- Bush, George, 569
- C
- Cagle, Eugene, 315
- California Institute of Technology, 23
- Canada
 - and *International Space Station*, 581
 - and participation on Space Station, 563
- Cape Canaveral, Florida, 23, 30
- Carruthers, John, 252
- Carter administration, 310
 - and threat to close MSFC, 165–66
 - lack of support for Space Station, 547
- Carter, James, 532
- Carter, Jimmy
 - space policy of, 310
- Centaur rocket, 45, 85, 138
- Cernan, Gene, 107
- Challenger*, 321, 323
- Challenger* accident, 339, 379, 389, 419, 508, 511
 - communications issues, 339–40, 349, 360–61, 374–78, 401–404, 408–10
 - congressional hearings, 405
 - impact on Space Station, 566–67
 - interpretations, 339–40, 348–49, 369–70, 404, 406
 - joint assembly issues, 395–96
 - legal issues, 414
 - media coverage, 391–93
 - MSFC reorganization, 410–11
 - NASA investigation, 391
 - recovery activities, 407–411
 - reform of launch procedures, 418
 - safety and quality issues, 397–99, 410–11
 - schedule pressures, 399–401
 - See also* Rogers Commission, solid rocket motor (SRM) joints, Space Shuttle mission STS 51–L
 - Shuttle propulsion redesign, 411–18
 - Shuttle versus Saturn technical culture, 399
 - technical investigation, 394–97
- Chamber of Commerce (Huntsville), 122
- Committee for Marshall Space Flight Center, 122
- Chappell, Charles R., 231, 456, 460, 579–80, 597–98
- Chassay, Roger, 252–53

- Chemical Weapons Service, 3
- Chrysler, 80, 84, 127
- Churchill, Winston, 8
- Civil rights, 115–25
- Civil Rights Act of 1964, 121, 125
- Civil Service Commission, 119, 141, 143, 159
- Cluster concept for S–IVB workshop, 184–85, 188
- Cluster engine configuration, 84
- Coal mining technology, 255–57, 260
- Coates, Keith, 355, 376–77, 395
- Cohen, Aaron, 409
- Cold War, 52
- Collier's, 180
 - 1952 articles on space travel, 20, 273
 - von Braun's 1952 articles, 528–29
- Columbia*, 317, 457
- Combustion instability, 88
- Comet Kohoutek, 235
- Command economy, 65
- Commercialization, 253–54
- Compton, Gene, 450
- Computation Laboratory, 41, 47, 96, 106
- Computer Operations Office, 63
- Concept Verification Test (CVT) Program, 541–43
 - and Space Station definition studies, 431–32
- Congress of Racial Equality (CORE), 117
- Congressional Budget Office
 - on Space Station budget, 572
- Connor, Bull, 118
- Containerless processors, 253
- Contractors
 - management of, 44–45, 193
 - penetration of, 44–45, 490
- Cook, Dick, 283
- Cooper, Charles R., 208
- Corning Glass, 493
- Corporal missile, 19
- Corrective Optics Space Telescope Axial Replacement (COSTAR), 516
- Cothran, Charles, 571
- Craft, Harry, 455, 457, 460
- Craig, Jerry, 544
- Cremin, J.W., 461
- Crippen, Robert, 358, 407, 418
- Crisp, Amos, 49
- Crumbly, Robert, 577

POWER TO EXPLORE: HISTORY OF MSFC

- Culbertson, Philip, 548, 558–61, 567
 - and realignment of Space Station work packages, 566
 - defies traditional Center strengths in Space Station assignments, 561–62
 - on Environmental Control Life Support System management, 564
 - on Space Station costs, 565
- Cumings Research Park, 129
- Curry, Joseph Ben, 118, 121
- D
- Dahm, Werner, 59
- Dannenberg, Konrad, 47–49, 55, 58, 157
- Darwin, Charles, 598
- Day, LeRoy, 285
- Debus, Kurt, 20, 30, 70
- Defense Logistics Agency, 397
- DeLoach, Tony, 195
- Delta launch vehicle, 138
- Deming, W. Edwards, 48
- Department of Defense, 20, 22, 40
 - and civil rights, 119
 - and establishment of NASA, 23–28
 - and participation in Space Tug, 433–34
 - and Space Station planning, 532
 - and transfer of von Braun team to NASA, 25–29
- Development Operations Division (ABMA), 2
 - transfer to NASA, 1, 2, 30
- Direct ascent mode
 - See* lunar landing mode decision
- Discovery*, 419
- Donlan committee, 441
- Donlan, Charles, 437
 - heads committee advocating Space Station, 533
- Donnelly, John P., 223
- Dora (concentration camp), 7, 10
- Dornberger, Walter, 5, 7, 10, 12, 26
- Dornier, 450
- Douglas Aircraft Company, 85, 180–81
 - See also* McDonnell Douglas
- Downey, James A., III, 241–42, 474, 475–76, 480, 483, 485, 514
- Driscoll, Dan, 285
- Drop Tube/Drop Tower, 250–52, 599
- Drucker, Peter, 564
- Dryden, Hugh L., 4, 26, 28
- DuBridge, Lee, 150, 275
- Dynamic overhead target simulator (DOTS), 602
- Dynamic Test Stand
 - and Shuttle testing, 314–15
- Dynamics Laboratory, 601

- E
- Earth orbital rendezvous mode
 - See* Lunar landing mode decision
 - Earth Orbiting Laboratory (EOL), 532
 - Eastman Kodak, 195, 489, 493, 513
 - Ebeling, Robert, 364
 - Edwards Air Force Base, 318
 - Ehl, James, 206, 208
 - Einstein's general relativity theory, 238–40
 - Eisenhower administration
 - and establishment of NASA, 23–28
 - and space policy, 2
 - Eisenhower, Dwight D., 23–24
 - and establishment of NASA, 25, 27–28
 - at MSFC dedication, 1
 - ELDO. *See* European Launch Development Organization (ELDO)
 - Electromagnetic Radiation (EMR) team, 241
 - Energy research, 254–60
 - Energy Research and Development Administration (ERDA), 257, 259
 - Energy, Department of, 257, 259–60
 - Enterprise*
 - at MSFC, 314
 - Environmental Control and Life Support System (ECLSS), 542, 568
 - assigned to MSFC for Space Station, 561–62
 - management of on Space Station, 564
 - MSFC development work on, 575–76
 - EOR (Earth-orbit rendezvous)
 - and Space Station, 530–31
 - Equal Employment Opportunity Program (MSFC), 125
 - ERNO, 445, 457
 - selection as prime contractor for Spacelab, 438
 - ESA. *See* European Space Agency (ESA)
 - ESRO. *See* European Space Research Organization (ESRO)
 - ESRO/ESTEC, 438
 - Eudy, Robert G. (Glen), 195, 344–45
 - European Launch Development Organization (ELDO), 433, 435
 - European Space Agency (ESA), 439, 442, 457, 482–83, 497, 510
 - and Space Station, 563
 - and Spacelab Instrument Pointing System development, 448–49
 - concerns about Spacelab program, 451–53
 - difficulties in Spacelab development, 444–48
 - European Space Research Organization (ESRO), 433–35, 437–40
 - and Instrument Pointing System (IPS) development, 449
 - European Space Technology Center (ESTEC), 445
 - Explorer I, 1, 23–24, 226
 - Explorer II, 24

POWER TO EXPLORE: HISTORY OF MSFC

- Explorer III, 24
- Explorer satellites, 41, 184, 227
- External tank (ET), 271
 - redesign, 412
 - See* Shuttle external tank
- Extravehicular activity (EVA), 186–87
- F
- F–1 engine
 - See* Saturn engines
- Faget, Maxime, 54, 179, 181, 188, 290
 - and Shuttle management, 283
- Failure Modes Effects Analysis (FMEA), 398, 411–12
- Fairchild Corporation, 228
- Feynman, Richard P., 370, 392, 399, 401
- Fichtl, George H., 461
- Filament wound case
 - on SRM, 322–23
- Finn, Terry, 550
- Flat electrical cables, 194
- Fletcher, James C., 160–61, 243, 255, 283, 405, 475, 479, 488, 570, 574
 - and 1986 Space Station realignment, 569
 - and contracting SRB, 290
 - and controversy over Thiokol SRM contract, 291
 - and Shuttle approval, 285–86
 - and Shuttle development, 281–82
 - and Space Station funding, 579
 - and threat to close MSFC, 165
 - chairs Space Station cost panel, 552
 - on ET costs, 302
 - on Spacelab weight problem, 438
 - on SSME development, 296–97
 - signs Spacelab Memorandum of Understanding, 437
- Flight readiness reviews, 350–51, 418
- Flippo, Ronnie, 453, 485
- Floyd, Henry B., 203
- Fordyce, Donald, 499
- Fort Bliss, 12–14, 19
- Foster, Clyde, 117–18, 120
- Freitag, Robert A., 544, 548
 - and industrialization as a justification for Space Station, 545
 - on MSFC-JSC competition, 549
- Friedman, Herbert, 474
- Frosch, Robert A., 165, 259, 301, 310, 316, 488, 548
- Fuller O'Brien Company, 354
- Future Projects Office (MSFC), 137, 180, 272–73, 529

G

- Gagarin, Yuri, 81
- Geissler, Ernst D., 94
- Gemini technology, 196
- General Accounting Office (GAO), 141, 251
- General Dynamics, 85
 - Shuttle Phase A study, 275
- General Electric, 9, 12, 14, 24
- General Motors, 103
- George C. Marshall Space Flight Center (MSFC). *See* Marshall Space Flight Center
- German rocket experts, 2–3, 20
 - and Arsenal system, 19
 - at Peenemünde, 5–8
- German rocketry, 5–8
- Giacconi, Riccardo, 245, 474
- Gibson, Roy, 445
- Gierow, Herm, 444
- Gilruth, Robert R., 53, 139, 149, 179, 188, 190, 204, 277, 541–42
 - advocates artificial gravity for Space Station, 535
- Glennan, T. Keith, 25–26, 28, 154–55
- Global Hydrology and Climate Center, 600
- Goddard Space Flight Center (GSFC), 138–39, 141, 166, 184, 226, 231, 238, 248, 252, 324, 453, 475–78, 555, 565, 572, 576
 - assignment of Space Station work package to, 559
 - competition with MSFC, 442
 - Space Station assignments of, 562
- Goddard, Robert, 528
- Godfrey, Roy, 283, 289, 293
- Goldwater, Barry, 121
- Gore, Al, 511
- Gorman, Harry, 148, 230
- GP–A
 - See* Gravity Probe-A
- Graham, William, 390, 566–68
- Grau, Dieter, 44–45
- Gravity Probe-A (GP-A), 238–40
- Gravity Probe-B, 598
- Gregg, Cecil, 545–46, 563–64, 574
 - on JSC management of Space Station, 565
- Griffin, Jerry, 551, 555, 559–62, 566
- Groo, E.S., 165–66
- Groupthink, 377
- Grubb, H. Dale, 106
- Grumman, 243, 281, 574
 - as Space Station integration contractor, 578
 - Space Station systems study, 544–45

POWER TO EXPLORE: HISTORY OF MSFC

- Guidance and Control Laboratory, 41–42, 94
- Guided Missile Center (Army), 21
- Guided Missile Development Division (Army), 19
- Gulf Stream Drift Mission, 201
- H
- H-1 engine, 27
- Haeussermann, Walter, 46, 94, 195, 197, 204, 399
- Hamill, James P., 9, 12–14
- Hardy, George B., 308, 345, 349, 353, 371–72, 376, 401, 406
- Harper's Ferry, West Virginia
 - and arsenal system, 19
- Harrington, James C., 454
- Harvard-Smithsonian Center for Astrophysics, 241
- Haynes, Joe D., 118, 121
- HEAO. *See* High Energy Astronomy Observatories
- Hearn, Glenn, 122, 126
- Hearth, Don, 560–62
 - 1985 critique of Space Station management, 565–66
- Heat sink, 21
- Heflin, Howell, 557
- Heimburg, Karl, 19–20, 43, 46, 94, 163–64, 399
- Heller, Hertha, 15
- Hercules Incorporated, 353
- Hermes missile program, 19
 - termination of, 20
- High Energy Astronomy Observatories (HEAO), 137, 157, 241–49, 431
 - Arsenal system, 246
 - budgetary troubles, 244–45
 - conflicts with scientists, 244–46
 - descooping, 242–43
 - Goddard-Marshall relations, 242
- HEAO-A, 243–44, 247–48
- HEAO-B, 243, 247–48
- HEAO-C, 243
 - operations, 247–48
 - scientific results, 248–49
- Hilchey, John, 443, 529, 531
- Himmeler, Heinrich, 7, 10
- Hinners, Noel, 324, 484–85, 487–88, 561
- Hitler, Adolph, 7
 - and V-2 development, 8
- Hjornevik, Wesley L., 26, 141
- Hocker, Alexander, 437–38
- Hodge, John, 548, 550, 560, 567
 - and “inside/outside” Space Station management, 568–69
 - on Space Station costs, 571

- Hoelzer, Helmut, 21
 Hollings, Ernest, 405
 Holmes, D. Brainerd, 56–57
 Holt, Denny, 573
 on JSC-MSFC cooperation, 577
 Honeywell SSME controller, 296–98
 Hoodless, Ralph, 456
 Hook, W. Ray, 570
 Hopson, George, 207, 542, 576–77
 Horton, William, 206
 Houbolt, John, 55
 Housing and Urban Development, Department of, 258
 Houston, Cecil, 374–75, 378
 Hubble Space Telescope (HST), 603–05
 1982 crisis, 497–504
 1983 reorganization, 504–07
 and closing of MSFC, 475
 and Program Development, 474
 associate contractors, 479–80, 489, 502
 congressional politics, 481–82, 484–85, 500–01, 503
 costs, 478–80, 483, 494–97, 503–04, 509
 Department of Defense, 490, 502–03, 512
 descoping, 495–96
 design, 474, 479–80, 483
 European Space Agency, 482–83, 485
 Fine Guidance Sensor (FGS), 490
 flight operations, 476, 486–87
 launch, 509
 management and communications, 500–03, 505–06
 mirror corrections, 515–16
 MSFC-GSFC relations, 475–78, 486–89
 Optical Telescope Assembly (OTA), 476, 479, 481, 483, 489, 491–92, 497–500, 507–08
 personnel cap, 490, 502
 pointing and control, 491
 primary mirror, 489, 493, 496–497, 500, 510–14
 protoflight, 479, 503
 repair and replacement, 491–92, 499, 505, 507–08
 scientific community, 477, 480–82, 501, 505, 513
 Scientific Instruments (SI), 476, 480, 505
 scientific results, 515–16
 See also Perkin-Elmer and Lockheed Missile and Space
 solar panel arrays, 497, 510
 Support Systems Module (SSM), 476, 479, 483, 489, 491, 508–09
 systems engineering, 476, 496, 506, 510

POWER TO EXPLORE: HISTORY OF MSFC

- Huber, William, 544–45
 - and studies of a modular Space Station, 538
- Human Relations Committee (Huntsville), 122
- Humphrey, Hubert H., 123
- Humphries, Randy, 561, 575–76
- Huntsville Arsenal, 3–4, 14
- Huntsville Industrial Center, 41, 86
- Huntsville Industrial Expansion Committee, 151
- Huntsville Operations Support Center (HOSC), 93, 106–07, 205–07, 210, 389, 391, 458, 462
- Huntsville, Alabama, 3, 99, 261
 - and impact of MSFC RIFs, 144, 159
 - civil rights in, 116–25
 - development and growth of, 1950-1970, 126–30
 - federal influence in, 3–4
 - impact of Germans, 14–16
 - post-Apollo economy, 151–52
 - reliance on federal funding, 128
- Hutchinson, Neil, 560–61, 565–66
- I
- IBM, 47, 91, 127, 194
- Incremental politics, 182, 191
- Information and Electronic Systems Laboratory, 481
- Instrument Pointing System (IPS)
 - on Spacelab 2, 462
 - See Spacelab
- Integrated Launch and Re-entry Vehicle (ILRV) task team (MSFC), 276
- Integrated Space Program (NASA, 1969), 150
- Interface Control Documents (ICDs), 441
- Intergraph, 128
- Interior, Department of, 255
- Intermediate Range Ballistic Missile (IRBM), 21, 24
- International Geophysical Year (1958), 23
- International Space Station (ISS)*, 581–82
- Investigators Working Group, 443
- IRBM. See Intermediate Range Ballistic Missile
- Ise, Rein, 193–94, 196–97, 215, 233
- Itek Corporation, 481
- J
- J.H. Wiggins Company, 399
- Jacobi, Walter, 163, 169
- James, Jack, 402
- James, Lee B., 17, 42–43, 67–68, 94–95, 99
- Japan
 - and *International Space Station*, 581
 - and participation on Space Station, 563

- Jean, O.C., 428–29, 441–42
- Jet Propulsion Laboratory (JPL), 1, 25–26, 140, 166, 226, 462, 511
and development of Explorer I, 23
- Jex, David, 441–42
- John F. Kennedy Space Center (KSC). *See* Kennedy Space Center (KSC)
- Johns Hopkins University, 488
- Johnson administration, 115
and post-Apollo planning, 137
- Johnson Space Center (JSC), 60, 90, 93, 101, 124, 138–39, 166–67, 179, 418
and competition with MSFC over post-Apollo projects
and controversy over lunar landing mode, 55–59
and lunar roving vehicle, 101–04, 106
and man-rating Mercury-Redstone, 80–81
and origins of Spacelab, 427
and reductions-in-force (RIF), 1970–72, 158
and Shuttle management, 281–83, 293
and Space Station planning, 532
and Space Station program definition studies, 536
and split of Space Station work packages, 559–61
as “host Center” for *International Space Station*, 582
compared with MSFC, 156
competition with MSFC, 139, 274, 279, 431–33, 442, 458, 541–42, 546, 555
competition with MSFC and LeRC over Space Station tasks, 557–62
divides Spacelab responsibilities with MSFC, 436
early Shuttle studies, 273–74
relations with MSFC during Apollo Program, 70
relations with MSFC on Spacelab, 440–41
See also Level II Shuttle Program Office, *Skylab*
Shuttle Program Office, 283
Space Station studies and proposals, 544–48
Space Station Work Package 2, 562
Spacelab responsibilities of, 441
- Johnson, Caldwell, 200, 204
- Johnson, Lyndon B., 24, 59, 121
and civil rights, 118–19
- Johnson, Roy W., 24
- Johnston, Garland, 307–08
- Joint Environment Simulator, 417
- Joint Spacelab Working Group (JSLWG), 437
- Jones, Charles O., 511
- Juno, 23–25
See also Saturn I
- Jupiter missile, 19, 21, 23
- Jupiter-C, 21–22, 24
as Explorer I launch vehicle, 23

POWER TO EXPLORE: HISTORY OF MSFC

K

- Kammler, Hans, 10
 - KC-135 aircraft, 104–05, 203, 251–52, 599
 - Keathley, William, 486–87
 - Keller, Sam, 460, 500–01, 505
 - Keller, Warren, 487
 - Kennedy administration, 115
 - and civil rights, 118
 - Kennedy Space Center (KSC), 90, 92–93, 162, 166–67, 282, 291, 303, 317, 370–71, 418, 441, 453, 457, 555
 - creation of, 70
 - Kennedy, John F., 53, 58–59, 121, 530
 - and civil rights, 117
 - Kennedy, Robert F., 118
 - Killian, James R., Jr., 24
 - Kilminster, Joe, 374
 - King, Martin Luther, Jr., 117–18
 - Kingsbury, James, 16, 198, 206, 212, 215, 238, 259, 349, 365, 378, 391, 395, 403, 406, 480, 489, 498, 514, 555
 - on ET challenges, 292
 - on ET design challenges, 302
 - on MSFC reorganization (1974), 164–65
 - on Shuttle management and engineering, 294
 - on SSME engineering challenges, 296
 - on welding technology, 321–22
 - on working with Europeans, 444–45
 - Kleinknecht, Kenneth S., 204
 - Knott, Karl, 460
 - Koelle, Hermann, 137, 180, 272, 580
 - and early Space Station concepts, 529–31
 - Kraft, Chris, 139, 144–45, 154, 162, 181, 188–89, 201, 362, 402, 405–06
 - and opposition to MSFC training payload specialists, 443
 - and Shuttle management, 283
 - argument for JSC payloads role, 432
 - on Headquarters pressure on Centers, 313
 - on MSFC management of Shuttle, 312
 - on Mueller, 149
 - on Shuttle financial control, 282
 - on Space Operations Center (SOC), 546
 - Krull, Gustave, 209
 - Kudish, Henry, 102
 - Kuettner, Joachim P., 81–82
 - Kurtz, H. Fletcher, 206
 - Kutyna, Donald J., 378
- ### L
- Labor unions, 61–63

- Laboratories, 40–42, 66–67, 197–98
 - and automatic responsibility, 47
 - reorganization of (1974), 164
- Lacy, Lew, 251
- Ladish Company, 362
- LAGEOS
 - See* Laser Geodynamic Satellite
- Lake Logan meeting, 101, 182, 188
- Lanchpad 39B, 378
- Land surveys, 255
- Langley Research Center (LaRC), 30, 55, 191, 275, 474, 570
 - and Space Station planning, 532
- Large space telescope (LST), 137, 157
 - See also* Hubble Space Telescope
- Laser Geodynamic Satellite (LAGEOS), 236–38
- Launch Operations Center
 - See* Kennedy Space Center
- Launch Operations Directorate (NASA), 30, 154
- Launch Operations Laboratory, 42, 61–62
- Lead Center
 - decision on Space Station, 554–55
 - JSC assigned Space Station, 557
 - MSFC and Spacelab, 439
 - MSFC assigned for Spacelab, 435–37
 - MSFC designated for Spacelab, 428–33
 - MSFC responsibilities on Spacelab, 448
 - NASA's assignment of post-Apollo responsibilities, 539–43
- Lead Center concept, 183
 - and Shuttle development, 281–83
- Lead laboratory system, 197–99
- Lee, Thomas J. (Jack), 317, 391, 435, 549, 573, 580–82
 - and workforce on Spacelab, 445
 - as Spacelab program manager, 437, 439–40
 - on assignment of Space Station work packages, 559
 - on communications with Europeans over Spacelab, 440
 - on inefficiency of Space Station interfaces, 578
 - on MSFC as Spacelab Lead Center, 428
 - on Space Station funding instability, 579
 - on Spacelab Instrument Pointing System (IPS), 448–49
- Lehrer, Tom, 135–36
- Lester, Roy, 462
- Letterman, David, 511
- Level I Shuttle Program Office (NASA HQ), 347, 351, 353, 356, 358, 360, 363–64, 367, 377–78, 400–01, 405, 407, 411–12, 418
- Level II Shuttle Program Office (JSC), 347, 351, 353, 360–61, 377–78, 400–01, 407–08, 411–12, 418

POWER TO EXPLORE: HISTORY OF MSFC

- Level III Solid Rocket Booster Project Office (MSFC), 355, 358
- Lewis Research Center (LeRC), 85, 137, 257–58, 320, 555, 565, 572
 - assignment of Space Station work package to, 559
 - competition with JSC and MSFC over Space Station tasks, 557–59
 - Space Station assignments of, 562
- Lilly, William, 290, 496
- Lindley, R.N., 447–48
- Lindstrom, Robert, 16, 293, 305, 318, 345, 349
- Littles, J. Wayne, 207, 318, 419
- Lockheed, 272, 291, 413, 484, 489, 495–96, 506, 508–09, 574
 - Shuttle Phase A feasibility study, 275
- Loewy, Raymond, 200
- Loftus, Joseph, 101, 549–50
- Logsdon, John, 402, 434, 511
- Lombardo, Joe, 16–17
- Lord, Douglas, 431, 434, 438, 440, 454, 458, 464
 - on Spacelab Instrument Pointing System (IPS), 449
- Lousma, Jack, 204
- Lovingood, Judson, 320, 352–53, 392, 395, 419
- Low, George, 101, 124, 149, 160, 162, 278, 281–82, 289, 485
 - on artificial gravity in Space Station, 535
 - on payload responsibilities, 437
- LTV, 138
- Lucas, William R., 22, 40, 43, 67, 87, 149, 161–62, 197–98, 225, 229, 252, 257–58, 357, 359, 371, 376–78, 392–93, 397, 401–05, 429, 476, 481–82, 487–90, 494–95, 497–98, 503–07, 514, 537, 544–45, 548, 551, 555–56, 560–62
 - and MSFC diversification, 428
 - and MSFC role in life sciences, 444
 - and MSFC Spacelab lead, 432
 - and Program Development Organization, 146–47, 150
 - and Shuttle management, 294–95
 - and Space Station planning in Program Development, 534
 - background, 17
 - compares MSFC and JSC, 154
 - on Concept Verification Test Program (CVT), 541
 - on European participation in Sortie Can, 434
 - on Martin Marietta ET management, 305–06
 - on MSFC retrenchment, 168–69
 - on project planning, 52
 - on Sortie Lab, 436
 - on Spacelab arrangement with Europeans, 440
 - on testing, 46
 - on threat to close MSFC, 165, 167
 - retirement, 406, 570

- Lunar landing mode decision, 53–59, 100, 180
- Lunar Module, 101–02, 184–85
- Lunar orbital rendezvous
 - See* Lunar landing mode decision
- Lunar Roving Vehicle, 57–58, 100–07
- Lunar soil studies, 104–05
- Lund, Robert K., 374
- Lundin, Bruce T., 211, 223
- Lundquist, Charles, 16, 213
- Lunney, Glynn, 353, 440–41
- Lyles, Garry, 419
- Lyndon B. Johnson Space Center. *See* Johnson Space Center (JSC)
- M
- Madison County, Alabama
 - and civil rights, 116–17
 - development and growth of (1950–1970), 126–30
- Magnetospheric physics, 600
- Mailer, Norman, 48, 50, 74, 98
- Main engines (Shuttle). *See* Shuttle main engines
- Man-computer Interactive Data Access System (McIDAS), 599
- Man-in-Space-Soonest, 24
- Man-on-moon decision, 53
- Manned Orbiting Laboratory (MOL), 532
- Manned Spacecraft Center (MSC). *See* Johnson Space Center (JSC)
- Manufacturing Engineering Laboratory, 42, 47, 194, 250
- Mark, Hans, 313, 356, 402, 547–49, 551, 557
- Marman, Richard A., 17
- Mars mission, 150–51, 166
 - and von Braun, 152
- Marshall Advisory Committee, 121
- Marshall Earth Science and Applications Program, 600
- Marshall Management Council, 409
- Marshall Space Flight Center (MSFC), 2
 - 1963 reorganization, 66
 - advanced studies (1980s), 598
 - and civil rights, 116–25
 - and competition with JSC over post-Apollo projects, 540–43
 - and funding in 1960s, 60–61
 - and *International Space Station*, 582
 - and legacies of Apollo Program, 107–08
 - and liquid vs. solid booster question, 284–86
 - and management of Saturn Project, 66–68
 - and publicity for Mercury-Redstone, 82
 - and Shuttle development, 271–325
 - and Shuttle management, 281–83
 - and Space Station program definition studies, 536

POWER TO EXPLORE: HISTORY OF MSFC

- and split of Space Station work packages, 559–61
- and unions, 61–63
- Apollo Program at, 596
- Army Arsenal system, 39–44, 64–65, 87, 211
- attempts to gain management of post-Apollo projects, 539–43
- background experience related to Space Station, 527
- changes due to Apollo Program, 59–71
- compared with JSC, 156
- competition with Goddard Space Flight Center (GSFC), 442
- competition with Johnson Space Center (JSC), 139, 274, 279, 431–33, 442, 457, 541–42, 546, 555
- competition with JSC over Space Station tasks, 557–62
- competition with other Centers, 555, 557–62
- contributions to Space Station, 580–81
- culture of, 39
- dedication of, 1, 30–31
- demise of arsenal system at, 165
- development of Spacelab, 427–64
- diversification, 179, 216, 225–26, 229–33, 258, 260–62, 597
- early Shuttle studies, 273–74
- engineering vs. science, 226, 231, 233
- expansion of role in space science, 443–44
- impact of Carter budgets, 310
- inter-Center competition, 231
- laboratories, 597–98
- management of Shuttle contracts by, 312–14
- management of SRB contracts, 311
- payload planning for Spacelab, 441–44
- performance as Lead Center on Spacelab, 464
- personnel in 1960s, 63–64
- physical appearance of, 40, 61
- post-Apollo adjustments, 596–97, 604–05
- post-Apollo manpower crisis, 140–44
- post-Apollo planning, 136–40
- post-Apollo reorganization at, 144–48
- reduction-in-force (RIF), 1970–72, 158–61
- relations with JSC on Spacelab, 440–41
- relations with NASA Headquarters, 537–38
- reorganization of (1974), 164–65
- reputation during von Braun years, 153–55
- retrenchment at, 167–69
- scientific strengths, 597
- Space Station studies and proposals, 544–48
- Space Station Work Package 1, 562
- Spacelab Mission Operations Control facility, 463

- summary of major activities, 595–98
- threat to close, 136, 165–67, 290
- under Rees, 157–58
- workforce at, 117, 121–22, 124–25, 136–37, 140–44, 167–68
- Marshall, George C., 28–29
- Marshall, Mrs. George C., 29–30
- Marshall, Robert (Bob), 59, 147, 153, 156, 164, 275, 313, 358–59, 403, 408, 429, 545–46, 548–49, 551, 555, 557
 - on boosting SSME power rating, 320–21
 - on Lucas’s Shuttle management, 295
 - on purpose of Space Station, 544–45
 - on reasons for Space Station, 527–28
 - on SSME development, 296
- Martin Marietta, 193, 234, 313, 321, 412, 563
 - and ET development, 302, 304–06, 308
 - MSFC concerns about ET management, 305–06
 - proposal (unsuccessful) for MSFC Space Station Work Package 1, 574
- Mason, Jerald E., 374
- Massachusetts Institute of Technology, 241
- Massey, John, 529–31
- Materials and Processes Laboratory, 492–93, 601–02
- Materials research, 249–54
- Mathews, Charles W., 202, 536
 - and Phillips review of Space Station management, 568
 - on artificial gravity in Space Station, 535
- Matrix management, 164, 261, 411, 478
- May, Karl, 12
- McCarty, John, 273, 300–01, 376–77
- McCool, Alex, 344–45, 349, 355, 409–10
- McCurdy, Howard, 182, 511, 548
- McDonald, Allan, 374–75, 400
- McDonnell Company, 81
- McDonnell Douglas, 138, 193, 211, 280, 433, 578
 - as SRB subcontractor, 309, 311
 - Shuttle Phase A feasibility study, 275
 - Space Station program definition study, 536–37
 - Space Station systems study, 544
- McDonnell Douglas Technical Services Company (MDTSC), 413, 450
- McDonough, George, 147, 188, 190, 197, 261
 - on MSFC reorganization (1974), 164–65
- McElroy, Neil, 22, 24, 28
- McGlathery, David M., 120
- McIntosh, Ron, 285
- McMillan, L.C., 119–20
- Medaris, John B., 52

POWER TO EXPLORE: HISTORY OF MSFC

- and launch of Sputnik I, 22–23
- and transfer of von Braun team to NASA, 25–29
- command of Army Ballistic Missile Agency, 21
- Mercury-Redstone rocket, 26, 80–82
- Merritt Island, Florida, 42
- Messerschmitt-Bölkow-Blohm (MBB), 438
- Michoud Assembly Facility, 63, 86, 121, 291, 293
 - and ET, 303–04
- Microgravity research, 249–54
 - See also* materials research
- Mikulski, Barbara, 511
- Miller, John Q., 345–46, 349–50, 355, 404
- Mir*, 582
- Missile Firing Laboratory (ABMA), 30, 70
 - See also* Kennedy Space Center
- Missile gap, 52, 93
- Mission to Planet Earth, 600
- Mississippi Test Facility, 63, 86, 92
- Mitchell, Edgar, 107
- Mitchell, Jesse, 474–76
- Mitchell, Royce, 417
- Mittelwerk, 7, 8, 10
- Mode decision
 - and Space Station, 531–32
- Module concept, 183
- Mondale, Walter, 310
- Moore, Jesse, 400, 401, 566, 569
- Moquin, Joe, 403
- Morea, Saviero “Sonny,” 87–88, 101–02
- Morgenthau, Henry, 9
- Morton, Rogers C.B., 255
- Morton-Thiokol Incorporated (MTI)
 - and capture feature, 353
 - and SRB testing, 309–10
 - and SRM joint tests, 341, 344–45, 350, 362
 - awarded SRM contract, 291–92
 - O-Ring Task Force, 364–66, 369
 - SRM redesign, 413–418
 - teleconference, 371–74
 - testimony, 392
- Mrazek, William A., 94
- MSFC. *See* Marshall Space Flight Center
- MTI
 - contractual issues, 365–66, 368–69
- Mueller, George E., 94, 101, 138–40, 145, 148–49, 154, 179, 181–82, 184–85, 200
 - and advocacy of Shuttle, 274–75

- and choice between Shuttle and Space Station, 536
- and civil rights at MSFC, 121
- and Integrated Space Program, 150
- and MSFC as Spacelab Lead Center, 428
- and origins of Spacelab, 427
- and Phillips review of Space Station management, 568
- and post-Apollo planning, 151
- attitude toward MSFC and JSC, 149
- on artificial gravity in Space Station, 534–35
- See also* all-up testing, *Skylab*
- Mulloy, Lawrence, 318, 323, 353, 355–58, 361–62, 364, 367–68, 371–72, 375–77, 403, 405–06
 - on ET design challenges, 302
 - on Shuttle project management, 294
- Mulroney, Brian, 563
- Multiple docking adapter (MDA), 185, 193, 207
- Murphy, James T., 431–33, 477, 484, 542
- Murray, Bruce, 140
- Musgrave, Story, 402
- Mutch, Thomas, 494
- Myers, Dale D., 279, 285, 407, 436, 475, 540–42
 - and cutting Space Station costs, 572
 - and Shuttle management, 281
- N
- NACA. *See* National Advisory Committee for Aeronautics
- NASA. *See* National Aeronautics and Space Administration
- NASA Management Council, 68, 407
- National Advisory Committee for Aeronautics (NACA), 3–5, 144
 - and long-range planning for space, 530
 - as predecessor agency to NASA, 24–25
- National Aeronautics and Space Act (1958), 25
- National Aeronautics and Space Administration (NASA), 1
 - and budget reductions, post-Apollo, 136
 - and civil rights, 116–25
 - and management of Space Station, 536–37, 547–62
 - and reductions-in-force (RIF), 1970–72, 158–61
 - and *Skylab*, 181, 202
 - See also* George Mueller
 - budget, early 1980s, 454
 - considers closing MSFC, 165–67
 - establishment of, 23–28
 - Propulsion Division, 362–63
 - tension between Centers and HQ, 549–50, 553–55
- National Aeronautics and Space Council, 25
- National Research Council (NRC), 323, 411, 413, 416
 - 1987 Space Station review, 573–74

POWER TO EXPLORE: HISTORY OF MSFC

- National Science Teachers Association, 232
- National Space Technology Laboratories (Bay St. Louis, MS), 299, 301
- Naugle, John L., 184, 442, 486
 - on distribution of Spacelab projects, 453–54
- Naumann, Robert, 18, 250
- Naval Research Laboratory, 234, 241
 - Project Vanguard, 20
- Nazi Party, 7, 9–10
- Neutral buoyancy simulator, 187–88, 208–10, 212, 492, 516
- Nevins, Clyde, 308, 319
- New Orleans, Louisiana, 63
- Newell, Homer, 139
- Nichols, Jack, 306, 321
- Nixon administration, 160, 535
 - and Shuttle decision, 430
- Nixon, Richard M., 150, 157, 275
 - and approval of Shuttle, 284–85
 - on goals for space program, 279–80
 - space policy of, 537
- Nordhausen, 7, 9
- North American Air Defense Command (NORAD), 214
- North American Aviation, 89–90, 272
 - See also* Rocketdyne
- North American Rockwell, 280, 288, 433
 - Shuttle Phase A feasibility study, 275
 - Space Station program definition study, 536
- Nova launch vehicle, 54–55, 137
- Nurre, Gerald, 510
- O
- O'Connor, Edmund, 67, 90
- O'Dell, Robert "Bob," 474, 477–78, 481, 486–87, 514
- O-ring Task Force
 - See* solid rocket motor (SRM) joints, O-Ring Task Force
- O-rings
 - See* solid rocket motor (SRM) joints, O-rings
- Oakwood College, 120
- Oberth, Hermann, 5, 528
- Odom, James, 44, 59, 89–90, 283, 317, 321, 506–08, 580
 - and Space Station funding, 579
 - as associate administrator for Space Station, 578–79
 - on complexity of Space Station management, 564
 - on ET production program, 302–04
- Office of Defense Mobilization Science Advisory Committee, 24
- Office of Management and Budget (OMB), 281, 310
- Office of Manned Space Flight (OMSF), 56, 140, 144, 159, 179, 181–82, 282, 293, 456

- and early Shuttle planning, 274
- and Space Station, 534
- and Space Station planning, 532
- Office of Space Flight, 546
- Office of Space Science, 455
- Office of Space Science and Applications (OSSA), 139–40, 474, 501
- Olivier, Jean, 490, 513–14
- Orbital Hardware Simulator Facility, 602
- Orbiter (Shuttle), 271
- Ordnance Guided Missile Center, 16, 19
- Ordnance Missile Command, 25
- Ordnance Missile Laboratory, 19, 21
- Organization and Management section (NASA), 144
- ORING computer model of SRM joint, 361
- OSS–1 (Spacelab mission), 456
- OSTA–1 (Spacelab mission), 455–56
- P
- Paetz, Robert, 159
- Paine, Thomas O., 148–50, 152, 155, 157, 160, 275, 281
 - and Space Station, 534
- Parker Seal Company, 346
- Parker, Robert, 463
- Parnell, Thomas, 246
- Payload Crew Training Center (PCTC) (MSFC), 443
- Payload Data Bank study, 432
- Payload Operations Control Center (POCC), 442, 457–58, 461
- Payload Planning Office (MSFC), 441–42
- Payload Requirements Board (NASA), 436
- Payload specialists, 443
- Payload studies, 431
- Payloads
 - MSFC enhances management responsibilities for, 436–37
- Peenemünde, 5–8
 - arsenal system at, 19
 - British bombing attack, 1943, 7
- Pellerzi, Leo, 142
- Peoples, Jerry, 367
- Perkin-Elmer (PE), 194, 237, 481, 489, 492–95, 497–500, 506–08, 511–14
 - See also* Hubble Space Telescope (HST)
- Pessin, Mike, 281, 303
- Petrone, Rocco, 105, 161–65, 206–07, 209, 243, 295, 436, 478
- Phased project planning, 147
- Phillips, Sam, 407
 - and review of Space Station management, 567–69
- Pickering, William H., 23
- Pogo effect, 95–98, 100

POWER TO EXPLORE: HISTORY OF MSFC

- Pohl, Henry, 16
- Popular Science, 49
- Post-Apollo planning, 181
- Potato, John, 311
- Powell, Luther, 548, 555, 561, 570, 573, 580
 - and Space Station management, 568
 - as MSFC Space Station project manager, 563
 - heads Space Station Concept Development Group (CDG), 551–52
 - on JSC management of Space Station, 565
 - on negotiating Space Station assignments with JSC, 560
 - on Space Station power module, 546–47
- Powers, Ben, 350, 377, 379
- Pratt & Whitney, 85, 280, 288, 320
 - protest over SSME contract award, 288–89
- Pregnant guppy, 92
- Preliminary Design Office (MSFC), 430
- President's Committee on Equal Employment Opportunity, 118
- Presidential Science Advisory Committee (PSAC), 24, 56, 58, 186
- Presidential Space Task Group (1969). *See* Space Task Group (1969)
- Productivity Enhancement Facility, 602
- Program Development Office (MSFC), 102, 146–47, 150, 225, 229, 255, 258, 545–46, 597
 - advocacy of MSFC payload work, 429–30
 - and payload planning, 441–42
 - and Shuttle planning, 282
 - and Sortie Lab, 436
 - and Space Station planning, 534
 - and studies of a modular Space Station, 538
- Project Adam, 24–25
- Project Cannon Ball, 237
- Project Hermes, 9, 12
- Project High Water, 227–28
- Project Horizon, 52, 180, 530
- Project management methods, 65–67
- Project Mercury, 25–26
- Project Orbiter, 20
- Project Overcast. *See* Project Paperclip
- Project Paperclip, 8–12
- Project Pegasus satellites, 93, 184, 212, 227–28
- Project Saturn, 27
- Project Vanguard, 20–21, 23, 25
- Propulsion and Vehicle Engineering Laboratory, 41, 96–97, 197
- Propulsion Laboratory, 410, 601
- Protoflight concept, 240, 244, 479, 503
- PSAC. *See* Presidential Science Advisory Committee
- Public Affairs Office (MSFC), 49

- Q
- Quality and Reliability Assurance Laboratory, 44, 46
 - Quality Laboratory, 42, 47, 237, 397
 - Quality methods, 43, 45–46
 - See also* test methods
 - statistical risk assessment, 45–46
 - Quality Office (MSFC), 397–98
 - Quarles, Donald A., 25
- R
- Randolph Products Company, 354
 - Raney, William P., 312–13
 - Ray, Leon, 345–46, 349, 353
 - Reagan, Ronald, 260, 390, 393, 547, 556, 563
 - Redesign of SRM
 - See* solid rocket motor (SRM) joints, redesign
 - Rednose Technical Society, 18
 - Redstone Arsenal, 1–3, 14, 16–17, 20, 26, 30, 314
 - Redstone missile, 40
 - Redstone Ordnance Plant, 3
 - Redstone rocket, 19, 25
 - reliability testing of, 20
 - See also* Mercury-Redstone
 - Redstone Technical Society, 18
 - Redstone Test Stand (“poor man’s” test stand), 18, 20
 - Reduction-in-force (RIF), 135
 - at MSFC, 1967–68, 142–44, 158
 - at MSFC, 1970–72, 158–61
 - Rees, Eberhard, 11, 45, 90, 95, 105, 145, 148, 161–62, 186, 201, 230, 317, 435–36, 474, 477, 537, 542
 - and competition with JSC over Sortie Can, 431
 - and liquid vs. solid booster question, 285
 - and Shuttle cost management, 287
 - and Shuttle management, 279–80
 - as MSFC director, 156–58
 - on ET development, 292–93
 - on flight anomalies, 100
 - on MSFC RIFs, 161
 - relationship with von Braun, 156–57
 - strategy for MSFC payloads role, 432
 - Reflective null corrector, 511–12
 - Regan, Donald, 390
 - Reinartz, Stanley, 17, 182, 189, 200, 366–67, 371, 374, 377–78, 406, 440
 - Relativity, theory of, 238–40
 - Reorganization
 - of MSFC (1974), 164–65

POWER TO EXPLORE: HISTORY OF MSFC

- Research and Applications Module (RAM), 282, 430, 432
- Research Projects Laboratory (MSFC), 137, 227, 249
- Rice, Bill, 348
- Richards, Ludie, 182, 206
- Richardson, Jerry, 507
- Ridgway, Matthew B., 14
- Riegle, Donald, 405
- Riehl, William, 374
- RIF. *See* Reduction-in-force
- Robertson, John, 17
- Rocketdyne, 280, 320
 - and SSME development, 296–301
 - selection as SSME contractor, 288–89
- Rocketdyne Division of North American Aviation, 53, 80, 83, 87–88, 89–90, 96–97
- Rocketdyne Division of Rockwell International, 403, 412
- Rockwell, 290
 - and SSME development, 297
- Rogers Commission, 339–40, 348, 352, 360, 364, 369, 373, 375–76, 378, 390–93, 396–97, 399, 401–04, 406
- Rogers, William P., 339, 390, 392, 396
- Roland, Alex, 402
- Roman, Nancy, 184, 488
- Roosevelt, Franklin D., 8
- Rosenthal, Max, 509
- Roy Gibson, 438
- Rudolph, Arthur, 67, 95
 - and concentration camp labor, 7
- Rummel, Robert W., 368
- Russia
 - and *International Space Station*, 581
- Rutland, Cary, 419
- S
- S–IC Test Stand, 79, 91
- Sanderson, Art, 17, 117
- Santa Susana, 296–97
- Saturn booster, 26–27
- Saturn C–1
 - See* Saturn I
- Saturn C–1B. *See* Saturn IB
- Saturn engines
 - F–1, 53, 79, 83, 85, 87–88
 - H–1, 84
 - J–2, 85, 89, 96–98
- Saturn I, 52, 83–84, 93, 129, 186
 - origins of, 25
- Saturn IB, 83, 93–94, 228–229, 237

- Saturn instrument unit, 91, 93
- Saturn launch vehicles, 46, 59, 83, 179
 - Block I missions, 93, 228
 - Block II missions, 93
 - checkout systems, 91
 - launches, 92–100
 - testing, 91–92, 94–95
 - transportation fleet, 92
- Saturn Program, 118
 - economic impact of, 126–129
 - impact of completion on MSFC, 136
- Saturn Program Control Center, 68
- Saturn stages
 - S-IC, 79, 85–86
 - pogo effect, 95–97
 - S-II stage, 44, 88–90, 96–98, 100
 - S-IVB, 84–85, 93–94, 96–98, 228
 - and *Skylab*, 44, 180–81, 184, 186–87, 196, 205
- Saturn Systems Office, 65
- Saturn V, 47, 53–54, 57–58, 79, 94, 129, 186–87, 190, 205
 - as symbol, 108
 - first launch, 95, 135
 - launch described by Norman Mailer, 98–99
- Saturn V Dynamic Test Stand, 92, 250
- Saturn V Program Office, 67–68
- Schardt, Alois W., 483
- Scheurer, James H., 405
- Schmitt, Harrison (Jack), 107, 258–59
- Schomburg, August, 30
- Schwartz, Dan, 244
- Schwinghamer, Robert, 198–99, 203, 206, 208, 322, 410
 - on relations with contractors, 313
 - on Shuttle, 325
 - on Shuttle testing vs. Apollo testing, 299
- Science and Engineering Directorate, 16
 - and management of SRB, 292
- Science and Engineering laboratories, 601
- Scott, David, 107
- Scout, 138
- Seamans
 - as head of NRC Space Station review, 573
- Seamans, Robert C., 141, 150, 275, 532
- Searcy, Robert B., 127
- Senate Committee on Aeronautical and Space Sciences, 29
- Shea, Joseph F., 56–57, 69, 532

POWER TO EXPLORE: HISTORY OF MSFC

- Sheldon, Charles, 155
- Shepard, Alan, 82, 107
- Shuttle Projects Office (MSFC), 293, 351
- Shuttle System Payload Data Study, 436
- Siebel, Mathias P., 47, 250–51
- Silverstein, Abe, 53, 85, 89, 185, 535
- Simmons, William K., 193, 200, 204
- Skylab*, 44, 58, 137, 157, 180
 - accident investigation, 211–12
 - and MSFC's diversification, 229
 - Apollo Telescope Mount, 193–95, 199, 234–236
 - arsenal system, 193–195, 199
 - as a step toward Space Station, 527, 533
 - as symbol, 216
 - biomedical technology, 202–204
 - Center competition, 179, 181–83, 188–89, 199–205, 215
 - cluster concept, 185
 - communications and control, 192
 - conservative engineering, 195–96
 - contractors, 192
 - design of, 184–91
 - development of, 191–205
 - division of responsibilities, 139
 - dry workshop, 189–90
 - funding of, 196
 - habitability, 200–02
 - launch configuration, 192
 - lessons learned, 212–13
 - management responsibility, 183, 196–97, 211
 - microgravity research, 250–51
 - operations of, 204–05, 212
 - origins of name, 191
 - planning for, 180–84
 - reentry, 213–15
 - rescue efforts, 205–12
 - scientific experiments, 232–36
 - See also* Apollo Telescope Mount (ATM)
 - spent stage workshop, 180, 182, 184, 186
 - student experiments, 232
- Skylab 1*, 205
- Skylab 2*, 205, 208, 210
- Skylab 3*, 210
- Skylab 4*, 235
- Smith, Gerald, 413–14, 417

Smith, Jim, 366, 376
Smith, Robert, 475, 503
Smithsonian Astrophysical Observatory, 236, 238, 239
Smoot, Charlie, 119
Sneed, William, 59, 68, 255, 282, 287, 393, 400, 429
Snoddy, William, 17–18, 227, 546
Society of Automotive Engineers, 365
Solar energy technology, 257–60
Solar physics, 600
Solid rocket booster (SRB), 271, 290, 316
 assigned to MSFC, 282
 development of, 308–11
 elimination of thrust termination, 290–91
 MSFC management of contract, 292
 ocean impact damage, 318–19
 recovery system, 308
Solid rocket motor (SRM), 289–90
Solid rocket motor (SRM) joints
 assembly procedures, 354, 357
 burst tests, 343–44
 capture feature, 353, 363, 415
 close-out, 368
 contractual issues, 365–66
 critical items list, 347–48, 351–53, 363
 design, 340–42
 erosion, 351, 354–55, 358, 360, 363, 371–74
 filament wound case, 353
 joint configuration, 341–42
 joint rotation, 343–46, 348, 352–53
 joint shimming, 344
 launch constraint, 360–61
 leak check, 342, 354–55, 361
 O-ring Task Force, 362, 364–366, 369
 O-rings, 316, 341–42, 346–47, 363
 post-accident redesign, 412–18
 post-accident testing, 416–18
 pre-accident joint redesign, 362–64
 pressure to launch, 375–76
 putty, 351–52, 354, 356–57, 363
 qualification of, 347–48
 referee test, 365
 static firings, 342–43, 345–47, 354, 367, 372, 417
 statistical analysis, 359, 361, 372–74, 398–99
 structural tests, 345–46
 subscale tests, 356
 teleconference, 370–78

POWER TO EXPLORE: HISTORY OF MSFC

- temperature issues, 347, 357–59, 362–63, 370–74, 392
- test flaws, 348
- versus Saturn testing, 349
- Solid Rocket Motor Branch, 345, 349, 365
- Sortie Can/Sortie Lab, 430–34
 - and influence on Spacelab, 431
 - costs, 436
 - European participation in negotiated, 434–36
 - European Phase A studies, 436
 - MSFC in-house definition studies, 435
 - negotiation of Memorandum of Understanding with Europeans, 435, 437
- Sortie Lab Task Force (NASA), 436
- South Atlantic Anomaly, 194–95
- Southern Pine Beetle, 255
- Soviet Union, 28
 - and launch of Sputnik I and II, 22–23
- Space and Rocket Center, 129
- Space Processing Applications Rockets (SPAR), 252–53
- Space Science Board of the National Academy of Sciences, 241
- Space Sciences Laboratory, 41, 104–05, 179, 194, 212, 230, 233–34, 474
- Space Shuttle, 604
 - approval of, 284
 - assignment of orbiter and booster development, 277
 - budget, 284
 - configuration, 271–86
 - constraints on development, 274–75, 279–81, 284
 - costs, 278, 287–88, 316, 323–24
 - development of, 271–325
 - early MSFC reusable vehicle studies, 272
 - early studies, 273
 - influence on Spacelab development, 440–41
 - launch rates, 323–24
 - maiden flight of, 317–18
 - management, 281–83, 293
 - modifications after first flight, 318–23
 - MSFC project management, 294–95
 - NASA rejects European participation in, 434
 - origins of the concept, 274
 - Phase A alternate Space Shuttle concepts studies, 280
 - Phase A feasibility studies, 275
 - Phase B systems studies, 279–86
 - Phase C/D development, 288
 - precursors, 271–72
 - program management, 287–88
 - recovery system, 318–19
 - selection of contractors, 286–93

- testing, 313–15, 317
- testing program compared to Apollo, 299
- See also* solid rocket booster (SRB); Space Shuttle external tank (ET), Space Shuttle main engines (SSME)
- Space Shuttle boosters
 - liquid vs. solid, 284–86
- Space Shuttle external tank, 316
 - configuration of, 283–84
 - contract to Martin Marietta, 293
 - design challenges, 302, 304–05
 - development of, 302–08
 - modifications after first flight, 321–22
 - MSFC concerns about Martin Marietta, 305–06
 - origins of the concept, 281
 - specifications, 292–93
 - test program, 306–08
 - welding technology on, 322
- Space Shuttle main engines, 271
 - assigned to MSFC, 282
 - attempts to increase power rating, 320–21
 - controversy over selection of Rocketdyne, 288–89
 - development of, 288, 296–301
 - early concepts, 273
 - engineering challenges of, 296, 299–301
 - modifications after first flight, 319–21
 - Pratt & Whitney protest, 288–89
 - redesign, 412
 - synchronous whirl rotor problem, 299
 - testing of, 299, 315, 317
 - turbine blade problem, 301, 319–20
- Space Shuttle Management Council, 418
- Space Shuttle Mission Management Team, 418
- Space Shuttle missions and SRM joints
 - STS 41-B, 354–55
 - STS 41-D, 357
 - STS 41-G, 357
 - STS 51-B, 359–63
 - STS 51-C, 357–59, 363, 371–72
 - STS 51-D, 354
 - STS 51-I, 367
 - STS 51-J, 367
 - STS 51-L, 339, 360, 367, 370–79
 - See also* Challenger accident
 - STS 61-A, 367, 372
 - STS 61-B, 367
 - STS 61-C, 367

POWER TO EXPLORE: HISTORY OF MSFC

- STS-13 (41-C), 355
- STS-2, 351-52
- STS-8, 354
- STS-9, 354
- Space Shuttle orbiter, 281, 283
- Space Shuttle Program, 161, 166
- Space Shuttle Range Safety Ad Hoc Committee, 399
- Space Shuttle Task Team (MSFC), 283
- Space Shuttle Verification/Certification Propulsion Committee, 347-48
- Space Station, 604-05
 - 1986 Configuration Critical Evaluation Task Force (CETF), 570-71
 - 1986 reorganization of, 567-69
 - 1993 redesign, 581
 - 25-kilowatt power module (MSFC proposal), 546-49
 - Architecture Control Documents (ACD), 577
 - artificial gravity debate, 534-35
 - assessment of program to 1990, 579-81
 - assessment of work package split, 559-60
 - attempt to divide development tasks, 549-50
 - budget, 552-53, 565-66, 576
 - Concept Development Group (CDG), 551-52
 - congressional challenges to, 579
 - costs, 570-73, 579
 - deferral and redefinition after Shuttle approval, 537-43
 - development work, 575-77
 - division of responsibilities, 556-62
 - dual keel as base configuration, 563-64
 - early conceptions of, 528-31
 - ESA participation on, 563
 - establishing management of, 549-53
 - field Center relations with NASA Headquarters, 536-37
 - habitation module, 576
 - impact of costs on program, 528
 - impact of politics on, 580-81
 - initiating Phase C/D, 572
 - Interface Control Documents (ICD), 577
 - international participation on, 563
 - justification for, 544-45
 - laboratory module, 576
 - life support systems, 541-43 (*See also* Concept Verification Test Program (CVT); Environmental Control and Life Support System (ECLSS))
 - management of, 553
 - Manned Orbital Systems Concept (MOSC), 544
 - MSFC Source Evaluation Board for Space Station, 574
 - Phase A conceptual studies, 533
 - Phase B definition studies, 533-34

- Phase C/D, 577
- planning, 1974-84 (evolution vs. revolution), 543-47
- post-Apollo proposals for, 532-37
- power tower adopted as reference configuration, 562-64
- presidential approval, 556
- program definition studies, 536
- Program Planning Working Group (PPWG), 551
- programmatically complex, 528
- Science and Applications Platform (SASP), 547
- Space Operations Center (SOC) (JSC proposal), 546, 548-49
 - systems integration, 577-79
 - threats to program in late 1980s and 1990s, 579-81
 - water for, 575-76
- Space Station Control Board (SSCB), 563
- Space Station Freedom*, 527, 579
- Space Station Management Colloquium (1983), 553-56
- Space Station Projects Office, 273
- Space Station Projects Office (MSFC), 563
- Space Station task group, 550, 553
- Space Station task team (MSFC), 544-45
- Space Systems Laboratory, 603
- Space task group (1969), 150, 275, 276-77, 279
- Space task group (STG), 30, 139
 - See* Johnson Space Center
- Space Telescope (ST)
 - See* Hubble Space Telescope
- Space Transportation System. *See* Space Shuttle
- Space Tug, 431, 433
 - NASA rejects European participation in, 434
- Spacelab, 166, 253, 282, 603-04
 - and *Skylab*, 236
 - and Space Station, 464
 - Astro-1 mission, 463
 - benefits to MSFC and NASA, 427
 - budget problems, 463-64
 - concerns over ESA performance, 444-48
 - costs, 440, 451-53
 - D-1 (German mission), 463
 - development of, 437-40
 - impact of budget cuts on, 454
 - Instrument Pointing System (IPS) development, 448-50
 - Memorandum of Understanding, 452
 - NASA-ESRO agreement, 439-40
 - origins of, 427-33
 - pallet modules on, 448
 - pallets, 456

POWER TO EXPLORE: HISTORY OF MSFC

- Phase C/D design and development, 437
- planning missions for, 441–44
- schedule of missions, 454
- science experiments, 442
- selection of name, 437
- selection of prime contractor, 437–38
- Spacelab Mission Operation Control facility, 463
 - technical challenges of, 448–51
 - unconventional nature of NASA-European relationship, 439–40
 - weight problem, 438–39, 451
 - workforce, ESA and NASA, 445
- Spacelab 1, 443, 457–60
 - experiments and equipment, 458–60
 - integration of payload, 457
 - payload of, 454–55
 - prelaunch preparations, 457–58
- Spacelab 2, 450, 455
- Spacelab 3, 456, 462–63
 - experiments and equipment, 461–62
- Spacelab 4, 454
- Spacelab 5, 454
- Spacelab 6, 454
- Spacelab Program Office (MSFC), 437
- SPAR
 - See* Space Processing Applications Rockets
- Sparkman, John, 14, 122, 125, 282
- Speer, Fred, 242–43, 245, 249, 488, 495, 501–03, 513
- Sperry Incorporated, 491
- Spherical aberration, 510–12, 515
- Spitzer, Lyman, 473, 477
- Splawn, James, 208
- Sputnik, 23–24
- Sputnik I
 - launch of, 22
- Sputnik II, 23
- SRB. *See* solid rocket booster (SRB)
- SRM. *See also* solid rocket booster; solid rocket motor
- Stalin, Joseph, 8
- State University of Iowa, 226
- State-of-Union Message, 390
- Static Test Tower, 91
- Staver, Robert, 9
- Stennis Space Center, 412
- Stewart, Frank, 288
- Stockman, David, 260, 555
- Stoewer, Heinz, 438

- Stofan, Andrew J., 225, 558, 561, 569–70, 578
 on Space Station power module, 547
- Stower, Heinz, 447
- Structures and Dynamics Laboratory, 602
- Structures and Mechanics Laboratory, 40–42, 510
- Structures and Propulsion Laboratory, 94, 345, 412, 492
- Stuhlinger, Ernst, 6, 15, 19, 40, 49, 56, 140, 148, 179–80, 184, 186, 212, 216, 225, 227, 229, 233–34, 241, 406, 474, 486
 and advocacy of MSFC work in payloads, 429
- Styles, Paul, 151
- Sullivan, O’Keefe, 570–71
- Super Guppy, 92
- Sutter, Joseph F., 393
- Systems Analysis and Integration Laboratory, 506
- Systems Dynamics Laboratory, 481
- Systems Engineering Laboratory, 214
- Systems management and engineering, 65–69, 197–98, 211–13
- T
- Tanner, Ray, 579
- Teacher-in-Space, 390
- Technology test-bed, 412
- Tektite II, 201
- Teleconference 27 January 1986
 See Solid rocket motor (SRM) joints, Teleconference
- Teledyne Energy Systems, 399
- Teledyne-Brown Engineering, 119, 128, 413, 574
- Teleoperator retrieval system, 213
- Tennessee Valley Authority, 4, 17
- Tepool, Ron, 300
- Tessmann, Bernard, 169
- Test Laboratory, 42, 46, 79, 94, 97, 227, 237, 314–15
- Test methods, 43, 46, 91–94
 and costs, 46
 See also quality methods
- Thiokol
 See Morton Thiokol Incorporated (MTI)
 See Morton-Thiokol Chemical Corporation
- Thomas, John W., 391, 394–95, 413, 415, 418
- Thomason, Herman, 214, 301, 319
- Thompson, J. R., 199, 202, 209, 317, 391, 396–97, 417–18, 419–20
 as MSFC director, 408–09
 as SSME project manager, 298–301
 becomes MSFC director, 570
- Thompson, Robert F., 188–89, 216, 293
- Thomson, Jerry, 272–73
 on SSME development, 299, 301

POWER TO EXPLORE: HISTORY OF MSFC

- Thor missile (Air Force), 21, 23
- Tiger team, 193
- Tiller, Werner G., 159
- Titan III-C, 341–42
- Toftoy, Holger, 9, 11–12, 14, 19
- Tompkins, Phillip K., 403
- Total Quality Management, 48
- Tousey, Richard, 234
- Transient Pressure Test Article (TPTA), 416–17
- Trichel, William, 9
- Truman, Harry S., 11
- TRW, 193, 242–43, 574
- Tsiolkovsky, Konstantin, 528
- Tuskegee Institute, 119
- Twin-pole sun shield, 208–210
- U
- UHURU x-ray satellite, 243
- United Space Boosters Incorporated (USBI), 292, 309, 413
- United Technology Center, 291
- University of Alabama, 17
- University of Alabama Huntsville Center, 120
- University of Alabama in Huntsville (UAH), 129, 153, 488
- V
- V–2, 5, 7–13, 26
 - American testing of, 12–13
 - and origins of Redstone missile, 19
- Van Allen, James A., 23, 226
- Vandenberg Air Force Base, 400
- Vehicle Assembly Building (VAB), 317
- Verschoore, Chuck, 306–07
- von Braun team, 16–17, 153, 162–64
 - and arsenal system, 19
 - and early Space Station concepts, 529–31
 - and Project Paperclip, 11
 - and Project Vanguard, 20
 - and RIFs, 159
 - at White Sands, 12–14
 - transfer from ABMA to NASA, 25–30
 - transfer to Huntsville, 14–16
- von Braun, Wernher, 1, 3, 16, 21, 24, 52, 55, 69–70, 79, 90, 95, 99–101, 116, 135, 161–62, 168, 179, 225, 229, 259, 279, 317, 536–37, 580
 - 1952 Collier's articles on space travel, 20
 - and arsenal system, 19
 - and civil rights, 119, 121–23
 - and communications, 50–51
 - and early Space Station concepts, 527, 529–30, 532–34

- and Huntsville development, 129
- and launch of Sputnik I, 22–23
- and lunar landing mode decision, 55–59
- and management system at Peenemünde, 6
- and manpower crisis, 141–42
- and Nazi Party, 7, 155
- and post-Apollo planning, 137–39, 151–52
- and Project Paperclip, 8–12
- and Shuttle planning, 277
- and *Skylab*, 180, 186–87, 189, 202–03
- and World War II German rocketry, 5–8
- as space publicist, 49–50
- at White Sands, 13–14
- becomes director of MSFC, 30
- early experience in rocketry, 5
- early Shuttle and Space Station concepts, 274
- leadership style, 48–49, 51
- leaves MSFC, 152–53
- legacy at MSFC, 153–55
- on arsenal system, 42
- on artificial gravity in Space Station, 535
- on Center reorganization, 144–46, 148
- on Center rivalry, 139
- on dirty hands leadership, 48
- on quality control, 44
- on the benefits of space exploration, 50
- relationship with Rees, 156–57
- retirement of, 163
- Space Station
 - debate over artificial gravity, 534–35
 - space telescope, 473–74
- von Saurma, Ruth, 15, 48
- von Tiesenhausen, Georg, 6, 49, 58, 144, 153, 155–56, 162
 - on Low as MSFC adversary, 149
- Voyager, 139–40
- W
- Waddy, Joseph, 143
- Wallace, George C., 116–17, 120, 123–25
- Wallops Island, 138, 166, 240
- War Eagle, 419
- Warren, A. P., 208
- Wear, Lawrence, 366, 376
- Webb, James, 45, 59, 65, 68, 138, 145, 148, 150, 229, 390
 - and civil rights, 117–19, 121–25
 - relationship with von Braun, 155
- Weekly notes, 51, 153, 295
- Weeks, L. Michael, 353, 405

POWER TO EXPLORE: HISTORY OF MSFC

Weiler, Ed, 511
Weinberger, Caspar, 556
Welch, James, 500, 503, 505
Welding technology, 87, 89–90
 on ET, 321–22
White Sands, 9, 12–13, 226, 252
Wiesman, Walter F., 13, 16
Wiesner, Jerome, 58–59
Williams, Frank, 180, 234, 273, 529
Willoughby, Will, 398
Winch, John, 106
Wojtalik, Fred, 506, 509, 514
Wood, Walt, 576
Wyle Labs, 413
X
X-ray Calibration Facility, 247
Y
Yardley, John, 301, 315
Yardley, John F., 438
York, Herbert F., 27–28
Young, John, 409, 417
Z
Zoller, Lowell, 238, 260, 445–46